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THE REPAIR OF SUBMARINE CABLES.

THE result of the expedition which we believe is now engaged in attempting the repair of the long-silent Atlantic cables will be looked for with great interest, not only by the shareholders of those companies which own long lines of cable, but by cable manufacturers also. To the former it will afford an insight into the durability of their property, and will show to what extent the reserve funds of the companies in which they are interested may be expected to be entrenched upon. To manufacturers who have an eye to business the result of the expedition will be of great importance. It will tell them whether they may look forward to fresh orders, either in consequence of the expedition proving futile, and the consequent necessity for new cables to be manufactured at no very distant dates, or should the attempts to repair prove successful it may, by inspiring confidence in the durability of cables, and the possibility of their repair in deep water even after a long immersion, give a considerable impetus to submarine cable enterprise in parts of the world which are at present destitute of telegraphic communication.

The possibility of repairing cables in deep water ceased to be a problematical question after the successful expedition of 1866; and to the breaking —perhaps we might almost call it "fortunate" breaking—of the 1865 Atlantic cable and its subsequent repair is no doubt owing the confidence which has led to so large an amount of capital being sunk in submarine cable securities.

Of the durability of the gutta-percha core of a cable there is, we believe, not the slightest doubt; of the durability of its protecting sheathing sufficient evidence has yet to be brought forward. Portions of cable have been recovered after many years' immersion in almost as perfect a state as when laid down; other portions have had their sheathings completely rotted away, and without any really satisfactory cause being assigned for the decay. Unless this decay can be prevented, the probability of raising a cable encrusted with a mass of half-decayed hemp and iron wire, which adds nothing to its strength and everything to its liability to break when subjected to the strain of a grapnel, is very small.

That a cable can be hooked by a grapnel at any depth to which it is likely to be laid, has been proved beyond dispute, but that it can be raised to the surface with certainty becomes a more doubtful question the longer the cable has been laid down.

To render the repair of deep-sea cables a matter of certainty more attention requires to be paid to their mechanical construction than has hitherto been the case. The point is too often lost sight of that the sheathing of a cable is not so much to enable it to be laid down as to enable it to be raised for repairs. A great deal, we fancy, might be done in the direction of rendering the gutta-percha core of a tougher nature than it is, as at present manufactured. Nearly all the skill in manufacturing gutta-percha has been turned in the direction of increasing its insulating property or decreasing its specific inductive capacity. A little attention in the direction of increasing its mechanical strength might prove of value. We believe that there is a great deal to be done in this direction, and that the cable of the future will be one whose principal mechanical strength will lie in its core, which is practically imperishable.

That it would be quite practicable to lay a deep-sea cable which had no outer protection beyond its gutta-percha covering is, we believe, the opinion of several competent engineers. Gutta-percha has a specific gravity nearly equal to that of water, and consequently the strain which it would have to bear at the surface of the water would not be heavy. The danger lies in sudden strains to which it may be subjected whilst being laid, but these are reduced to a minimum in the smooth-working machinery now employed for paying out.

A cable of this kind once laid down would remain unaltered for years, and at any time would be in a condition to stand the strain of picking up.

The advocates of the light cable system have had these considerations in view, and although they have received the support of those best qualified to judge upon such matters, their schemes have not as yet received sufficient public support to enable them to be carried out. The result of the repairing expedition we have referred to may, however, go far towards reviving the idea.

THE ANGLE OF MAXIMUM SENSITIVENESS IN GALVANOMETERS.

By H. R. KEMPE.

IN using the tangent galvanometer for making a test it is always as well, by adjusting the battery power or the resistances, to avoid obtaining either very high or very low deflections. The reason for this is, that any slight error made in reading off the deflection from the scale, such as would be caused from the index-hand of the needle not pointing exactly to one of the graduations on the scale,

causes a greater error in the result worked out from a formula when the deflections are very low or very high, than when they have an intermediate value. Thus, for example, to take extreme cases, suppose, owing to the graduations of the scale being coarse, we judged that the index-hand pointed to 6°, whereas it was really only at 5°, or *vice versâ*, then the current strengths represented by these degrees will be tan. 6° and tan. 5°, or ·104 and ·087. Again, supposing we read 43° as 42°, or *vice versâ*, then the respective current strengths will be ·682 and ·669. Lastly, suppose we read 81° as 80°, or *vice versâ*, then the current strengths will be 6·31 and 5·67.

Now

tan. $(a^\circ + 1^\circ)$		tan. a°		
·104	:	·087	: :	100 : 84
·682	:	·669	: :	100 : 98
6·31	:	5·67	: :	100 : 90

On examining these figures it will be seen at once that the relative values of the true and observed deflections are much nearer an equality in the case where these deflections are neither very low nor very high. It follows, therefore, that there must be some deflection which makes this approximate equality the closest possible.

Now the numbers 84, 98, and 90 are to one another in the ratio of the different values of the fraction $\frac{\tan.\ a^\circ}{\tan.\ (a^\circ + 1^\circ)}$, and when this quantity has a maximum value, then the best value of a° is obtained.

We have, then, calling δ° the error of observation,

$$\text{if } u \quad \frac{\tan.\ a^\circ}{\tan.\ (a^\circ + \delta^\circ)} = \frac{\tan.\ a^\circ\ (1 - \tan.\ a^\circ \tan.\ \delta^\circ)}{\tan.\ a^\circ + \tan.\ \delta^\circ}$$

$$\frac{du}{d\tan.\ a^\circ} = \frac{1}{(\tan.\ a^\circ + \tan.\ \delta^\circ)^2}\left((\tan.\ a^\circ + \tan.\ \delta^\circ)\frac{1 - 2\tan.\ a^\circ \tan.\ \delta^\circ}{\cos^2 a^\circ} - \frac{\tan.\ a^\circ\ (1 - \tan.\ a^\circ \tan.\ \delta^\circ)}{\cos^2 a^\circ}\right) =$$

o at a maximum.

Therefore,

$$2\tan.^2 a^\circ \tan.\ \delta^\circ + 2\tan.\ a^\circ \tan.\ \delta^\circ - \tan.\ \delta^\circ - \tan.^2 a^\circ \tan.\ \delta^\circ = o.$$

Therefore,

$$\tan.^2 a^\circ + 2\tan.\ \delta^\circ \tan.\ a^\circ = 1,$$

from which

$$\tan.\ a^\circ = + \sqrt{\tan.^2 \delta^\circ + 1} - \tan.\ \delta^\circ$$

Now, since the error δ° is very small, by putting it equal to o we get

$$\tan.\ a^\circ = 1 \text{ or } a^\circ = 45^\circ$$

We see, then, that in order to get the greatest possible accuracy we should obtain deflections as near 45° as possible.

In making this investigation, we have supposed the error δ to be a + quantity, but the same result would be arrived at if δ had been a — quantity.

To follow out this rule when comparing two deflections, we should get the deflections on either side of 45° in preference to having them both on one side. Thus, if we obtained deflections of 5° and 13° in making an experiment, it would be preferable to increase the battery power or adjust the resistances so as to obtain deflections of 31° and 58°, for the ratio of the tangents of the angles in both cases is the same, that is

tan. 5° : tan. 13° : : tan. 31° : tan. 58°

but the error which would result when the formula in which these tangents appear is worked out would be greater if we read 13° as 14° than if we read 58° as 59°.

If we require to adjust two currents in two different measurements so that they should be equal in both cases, it is evident that the needle of the galvanometer employed to measure them should in each case show the same deflection.

In making the two measurements we take the deflection obtained by one current as the standard, and then in making the second measurement we adjust the current until the same deflection is obtained.

Now it is evident that the accuracy with which we can adjust this current depends upon the sensitiveness of the galvanometer to a change in the strength of the current, and when any small change in the current produces the greatest possible change in the deflection the maximum sensitiveness is obtained.

From the investigation made in the case of the tangent galvanometer it is evident that this *angle of maximum sensitiveness* is obtained when the needle points at 45°. If, therefore, we employ a tangent galvanometer for such a test as that just mentioned, we should endeavour to bring the needle to 45° in both measurements.

It must be evident that all galvanometers have an *angle of maximum sensitiveness*, though it is not the same in all. The angle depends upon the shape of the coil, length of the needle, &c. It can, however, be found for any galvanometer.

The angle being once found should be marked on the galvanometer for future reference.

INDIA-RUBBER CONSIDERED IN REFERENCE TO ITS APPLICATION TO TELEGRAPHY.

By THOMAS T. P. BRUCE WARREN,
Analytical Chemist to the India-rubber, Gutta-percha, and Telegraph Works Company, Limited.

(*Continued from page* 136.)

IN examining the chemical and physical properties of caoutchouc, it will be more convenient to refer, in the first place, to what has been done by others, supplementing or correcting where it appears to the writer that imperfect or erroneous deductions have been made, reserving for a future communication my original researches on this substance.

During the last few years several eminent chemists have contributed to our knowledge of this substance, amongst whom may be mentioned Thomson, Faraday, Ure, Graham, Miller, Gregory, Williams, Abel, Hoffman, Adriani, and Spiller. I propose in the present paper to consider the properties of india-rubber under the following forms;—

Firstly. The natural juice.

Secondly. Commercial caoutchouc or india-rubber.

Thirdly. Pure caoutchouc.

The natural juice.—I believe that the writer was the first who showed that free ammonia existed in the juice of the *Siphonia*. When the juice is

properly protected in a closely stoppered or corked bottle, it remains unaltered for a very long time. In the juice of the *Massaranduba* or "Cow Tree," of Brazil, I found that a very much larger quantity of ammonia exists. The gentleman from whom I obtained it assured me that it was exactly in the same state as when gathered from the tree. The inference drawn from these cases is that the emulsiveness of the caoutchouc is due almost entirely to ammonia.

Whilst on this point I may mention, by way of showing what inaccuracies exist in our chemical accounts of this substance, that in Schorlemmer's Hydrocarbons,* it is stated that the juice is acid. Now if a piece of turmeric paper be moistened with the diluted or natural juice, it is readily turned brown; the discoloration of the turmeric, however, is fugacious, disappearing when slightly heated, which shows the absence of fixed alkalies, or alkaline salts. A glass rod dipped in hydrochloric acid and held over an open bottle containing the juice does not give distinct clouds with the juice of the *Siphonia*, but the ammoniacal odour of the *Massaranduba* juice is unmistakably evident.

If a little weak hydrochloric acid, or any other mineral or organic acid, be added to the juice, it coagulates, and after a short time the caoutchouc separates cream-like on the surface of the liquid, which retains a milky cloudiness. In the same way, if the juice be exposed to the air it soon coagulates—this perhaps results partly from the loss of the ammonia and the generation of acetic or mucic acid, for the liquid now gives a decidedly acid reaction. Ammonia is, on this account, sometimes added to the juice to maintain the emulsiveness of the caoutchouc.

The fact that acids coagulate the juice or cause the caoutchouc to coalesce is said to be taken advantage of in several countries, particularly those from which the African varieties are obtained. A friend of mine has informed me that large quantities of mineral acids are shipped from the Cape to African ports for this purpose. It is well known that the juices of other trees or shrubs are added to bring about the same result. The *Bejuca*, a member of the *Apocynaceous* group, is said to be extensively used in Nicaragua for this purpose. Edwards, in his travels on the Amazon, gives us to believe that the admixture of other juices with the *Siphonia* is practised.

I cannot gather any information on these juices, which are said to coagulate the india-rubber juice, and I would therefore only suggest that such juices, by possessing a greater proneness to ferment, more readily generate the acids necessary to neutralise the alkalinity of the india-rubber juice, and so bring about the coalescence of the caoutchouc.

Alum and other acid salts are said to be used in Brazil, but this, I think, requires confirmation. No difficulty should exist in proving or controverting this very important statement, for we might certainly expect to find such substances in the caoutchouc, as by the processes of dissipation the salts or acids would remain to some extent blended with the caoutchouc. The seriousness of such practice needs no comment where the article itself is to be applied for insulating purposes.

* Macmillan. London, 1874.

An examination of the wash waters from india-rubber may be expected to give important information to the manufacturer and to chemico-botanical research, as it should be easy to distinguish the source of any variety of india-rubber if we knew what salts and proximate principles were contained in the different juices of caoutchouc-producing trees.

It was proposed at one time to import the natural juice, and to coat copper wires with caoutchouc in the same way as the bottles themselves are made up, that is, by drying upon it a successive series of coats. The inappropriateness of the idea arises from the fact that such coatings could not possibly be rendered homogeneous, even supposing that every other difficulty could be overcome. A friend of mine at Cayenne hit upon this same idea a few years ago.

The quantity of caoutchouc contained in the juice is said to vary according to the part of the tree from which the sample is obtained. I give Adriani's experiments with the juice of the *Ficus elastica* (a young tree 2·25 metres in height):—

Amount evaporated.	Height tapped.	Total residue.	Per cent.
0·183 grms.	at 0·30 metres.	0·046 grms.	25·15
0·395 „	„ 1·74 „	0·095 „	24·05
0·143 „	„ 2·10 „	0·030 „	20·98
0·825 „	„ Top. „	0·145 „	17·70

I can easily understand, as it has been confirmed by other experiments as well, that the older portions of the tree, and those incisions made nearest the root, give a greater yield of juice; but when a tree is tapped, and some of its juice drawn off, we know that tapping again, even in the neighbourhood of the previous incision, will yield a weaker juice as regards the quantity of caoutchouc. The experiments of Dr. Adriani in showing that caoutchouc is unequally distributed in the plant, to the extent he states, are, to my mind, not quite conclusive; it has been stated, too, that from the *Ficus elastica* the *quantity of juice* increases with the height of the incision from the root.

Adriani says that alcohol produces a coagulation of the juice, whilst Ure states that in two samples of juice containing 20 per cent. and 37 per cent. of solid caoutchouc, alcohol of 0·825 specific gravity afforded no appearance of coagulation when mixed with them in any proportion. My own observations confirm those of Dr. Ure; still, the juice operated on by different experimenters may produce these apparently anomalous results. Juices containing gummy matter coagulate on the addition of alcohol. The fact that no coagulation is produced by adding alcohol to the juice led Ure to question the existence of albumen as pointed out by Faraday's analysis.

Adriani says that the juice of the *Ficus* reddens litmus, and consequently contains a free acid, or an acid salt. He further states that hydrochloric acid when added to the milky juice produces no effect. These statements require confirmation.

Muspratt gives the specific gravity of the juice - - - - - -	1·012
Ure (containing 37 per cent. caoutchouc) - - - - - - -	1·0175
Ure (containing 20 per cent. caoutchouc) - - - - - - -	1·04125
My own experiments on a juice containing 35 per cent. give - -	0·988

The following analysis of the juice of the *Ficus elastica* is taken from Adriani's paper :—

Water	82·30
Caoutchouc	9·57
Resin, Soluble in Alcohol but not in Ether	1·58
Magnesia, combined with peculiar organic acid	4·49
A Substance, Soluble in Water and Alcohol, but not in Ether (Sugar &c.)	0·36
An Organic Substance, Soluble in Water, takes a yellow tinge with alkalies (dextrine), and traces of salts of lime and soda	2·18

Faraday's analysis of the juice of the *Siphonia cahuchu* yields :—

Caoutchouc	31·70
Albumen	1·90
Bitter nitrogeneous substance, soluble in water and alcohol	7·13
Substance, soluble in water, insoluble in alcohol	2·90
Wax	trace
Water, containing a little acid	56·37

As this sample was confined in a copper vessel for some months, we must not attach too much importance to it. The absence of ammonia in the analysis of Faraday, Ure, and Adriani made me the more cautious when my specimens were gathered at Para.

The ultimate composition of caoutchouc will be noted under the head "Pure Caoutchouc."

The examination of the juice under the microscope leads to the conclusion that the caoutchouc is diffused through the juice in the form of minute spherical globules, the measurements of which are given by Adriani as varying from $\frac{1}{12000}$th to $\frac{1}{30000}$th and $\frac{1}{50000}$th of an inch in diameter. This appearance is identical with oily or resinous substances when they are emulsioned by means of gum or sugar.

I shall have occasion to refer to these measurements by Adriani when speaking of "Manufactured caoutchouc."

Our information is not very extensive as to what the different kinds of trees will produce, nor to what extent this tapping can be borne by them. The *Massaranduba* juice flows much more freely than that from the *Siphonia*, although the amount of caoutchouc is greater in the former than in the latter; in appearance too it is much more limpid. It is said that the *Ficus elastica* may be safely made to yield 42 lb. juice, which can be repeated once a fortnight. An *Urceola elastica* can, without being injured, yield 50 to 60 lb. of caoutchouc in one season, or from 120 to 150 lb. juice. Edwards says it occupied a labourer on the Amazon a whole day in collecting from 120 trees (*Siphonia*) about two gallons of juice. This would correspond, according to Faraday's figures, only to about 6¼ lb. caoutchouc. The existence of ammonia in the juice of the caoutchouc (*Siphonia*) has not been mentioned by any other writer, as far as I am aware. Ure states that he obtained a little nitrogen in his analysis, but he does not indicate from what principle or constituent of the juice it is derived.

The omission of ammonia in Ure's and Faraday's analyses may be easily explained by the fact that the juice upon which they operated had been confined for some time in a copper vessel.

Faraday and Ure confirm the existence of a nitrogeneous substance in the juice, but make no mention of ammonia. It might, therefore, be suggested that the ammoniacal odour of the juice arises from the decomposition of this nitrogeneous substance.

Some years ago I obtained from a sample of Borneo rubber a nitrogeneous substance having well-defined alkaloidal properties. A sample of Para rubber yielded a substance more similar in its chemical properties to fibrine, of which probably it is a soluble modification. A special examination was made to establish its identity with albumen in support of Faraday's statement, but no trace of albumen was found.

Commercial Caoutchouc, or India-rubber.—The different kinds of india-rubber met with in commerce must be regarded as mixtures containing more or less of an isolable hydrocarbon, which chemists term caoutchouc, and the other non-volatile constituents of the juice, together with the products resulting from oxidation and other causes with which we are only familiar from the appearance and consistency of the raw article.

The colour of Para rubber, when fresh cut, is a pale yellowish white, which, on exposure to the air, gradually becomes darker, and inclines to a dark brown. I have never seen a specimen by mere exposure take the dark blackish colour sometimes met with on the outer surface of the Para bottles; and I am inclined to think that this dark colour is produced during its manufacture. My friend, Senhor Picanco, of Para, gave me a large india-rubber ball which was almost perfectly black on the outside. Now mere oxidation would have required some months to have produced this appearance, whereas it was manufactured from the juice only a few days before I received it. The india-rubber itself, although now four years old, is as sound as when I first received it.

Some varieties of india-rubber when fresh cut have a singular greyish-white tint, and become quite black on exposure to the air for a short time, whilst others take a delicate pinkish or red colour which is only heightened by exposure.

Spruce says that some of the varieties of the *Siphonia* met with on the Rio Negro and other tributaries north of the Amazon give a caoutchouc which blackens on exposure to air.

There is no doubt but that a careful examination of these phenomena must result in important additions to our commercial knowledge of this substance.

I made an analysis some years ago of the substances dissolved out of the thin laminæ of a Para bottle. I am unable at present to refer to the results then obtained. I recollect that the liquid was decidedly acid, and, by carefully evaporating in a water-bath, yielded about ·4 per cent. of solid matter. The india-rubber itself was perfectly white, but the water was decidedly brown. I have now a specimen of *Massaranduba* juice which has become coagulated by being imperfectly sealed up. The liquid portion is changed to the colour of dark ale. These remarks are sufficient to show that our knowledge of the juices yielding caoutchouc must not be made to rest upon the examination of the liquids obtained by digesting commercial samples in

distilled water, but that we must carefully take into account such changes, which may be the result of fermentation or catalytic action. Ure gives the following specific gravities taken in dilute alcohol :—

Best Para	0·941
„ Assam	0·942
„ Singapore	0·936
„ Penang	0·919

The specific gravity of a specimen prepared by Faraday from the juice in a pure state was found to be 0·92.

Soubeiran gives	0·9355.	
Payen	„ 0·9250.	
Adriani	„ 0·9628	crude caoutchouc of India.
„	„ 0·9452	black caoutchouc.
Julian	„ 0·9200.	

Moisture, imprisoned in the india-rubber, is quite sufficient to explain the wide differences in these figures. My own determinations, taken on very old and well-seasoned Para, and cutting out the unaltered portions from the bottle, give from 0·917 to 0·926.

It is well known that the Para bottle rubber may be kept, under ordinary circumstances, for a great number of years without showing any signs of decay, and in the earlier days of insulating with india-rubber this fact was taken advantage of. Strips of this rubber could not well be united, and consequently its use was soon discontinued.

A very singular circumstance occurred with this mode of insulating, which manufacturers have certainly lost sight of, or at least failed to turn to account. The india-rubber remained perfectly sound, and if applied over a plain copper wire a green coating was first formed, which gradually darkened and became sticky, but requiring a much longer time to soften than masticated rubber. On a tinned wire it was found to last for years unaltered.

This fact is sufficient to show that india-rubber, or rather caoutchouc, has no inherent tendency to become soft and sticky, and that this tendency is imparted to it by the processes of manufacture.

Pure Caoutchouc.—This substance, according to the analysis of Faraday, is represented by the formula C_8H_7, or some multiple of this.

He found	87·2	carbon, and	12·8	hydrogen.
Ure gives	90·0	„	10·0	„
C. G. Williams	86·9	„	12·4	„ loss 0·7.
„	87·3	„	12·1	„ loss 0·6.

Ure suspected an error in Faraday's analysis, arising from the difficulty of thoroughly burning the carbon with oxide of copper. Faraday's figures are so well confirmed by those obtained by Williams, Dr. Miller, and myself, that this formula, or some multiple of it, can be safely accepted. As the atomic weight of carbon, however, has been doubled since this formula was announced, it will now stand $C_{16}H_7$, which gives 87·3 per cent. carbon and 12·8 per cent. hydrogen. Ure's analysis will require $C_{15}H_{20}$ as the formula for pure caoutchouc, which exactly corresponds with the results he obtained.

My own observations show that oxide of copper cannot be depended upon for the complete combustion of caoutchouc : an error is likely to be produced, partly by the incomplete combustion of its carbon, and the escape of a little volatile matter which the heated oxide of copper is incapable of burning, especially if generated too rapidly. This difficulty is not removed even by the assistance of oxygen or chlorate of potash. I therefore prefer using chromate of lead, which gives constant and reliable results, especially with vulcanised india-rubber. A long combustion-tube must be used, and a few inches of oxide of copper kept ignited near the absorption end will prevent the escape of any volatile hydrocarbon, generated by incautious heating, without being burnt.

It is not within the province of this paper to deal with the substances derived from caoutchouc by destructive distillation. I shall therefore merely give the names of those substances which have been obtained and are well described in the most recent works on organic chemistry :—

Caoutchine ...	carbon 88·44,	hydrogen	11·56.
Isopropene ...	„ 88·00,	„	12·10.
Caoutchène.			
Hévéène.			

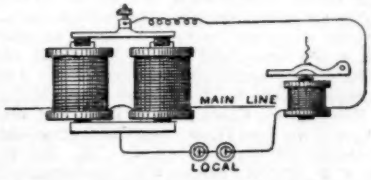
Other derivatives and substitution products are known, but as they are of no special interest to the electrician their mention would be out of place here. The peculiar property, however, which isopropene is said to possess in absorbing atmospheric oxygen and converting it into its allatropic condition—ozone, may be mentioned here, but further reference to this fact will be made when treating of the manufacture of india-rubber for insulating purposes.

The solution of caoutchouc in rectified ether is precipitated on the addition of alcohol, which affords a method of obtaining this substance in a state of purity, as the resinous or oxidised portions remain dissolved.

It dissolves readily in chloroform, bisulphide of carbon, turpentine, and the mineral liquid hydrocarbons obtained in the distillation of coal, &c., and which are known in commerce as naphthas.

EDISON'S PRESSURE RELAY.

MR. EDISON has recently invented an ingenious and novel relay instrument, based upon an entirely new principle. He takes advantage of the property



which plumbago possesses of decreasing its resistance enormously under slight pressure. Thin discs of that material are placed upon the cupped poles of an electro-magnet (see diagram), the coils of which have several hundred ohms resistance. Upon the discs of plumbago is laid the armature, which is provided with a binding-post for clamping the local battery wire.

The cores of the magnet, the plumbago discs, and

the armature are included in a local circuit, which also contains an ordinary sounder and several cells of bichromate battery. The relay magnet is inserted in the main line in the usual manner. The operation is as follows: When the main circuit is opened the attraction for the armature ceases, and the only pressure upon the plumbago discs is due to the weight of the armature itself. With this pressure only, the resistance of the plumbago to the passage of the local current amounts to several hundred ohms; with this resistance in the local circuit the sounder remains open. If now the main circuit be closed, a powerful attraction is set up between the poles of the relay magnet and its armature, causing a great increase in the pressure upon the plumbago discs, and reducing its resistance from several hundred to several ohms, consequently the sounder closes. So far the result differs but little from the ordinary relay and sounder. But the great difference between this relay and those in common use, and its value, rests upon the fact that it repeats or translates from one circuit into another the relative strengths on the first circuit. For instance, if a weak current circulates upon the line in which the relay magnet is inserted, the attraction for its armature will be small, the pressure upon the plumbago discs will be light, consequently a weak current will circulate within the second circuit; and, on the contrary, if the current in the first circuit be strong, the pressure upon the plumbago discs will be increased, and in proportion will the current in the second circuit be increased. No adjustment is ever required. It is probably the only device yet invented which will allow of the translation of signals of *variable strengths*, from one circuit into another, by the use of batteries in the ordinary manner. This apparatus was designed by Mr. Edison for repeating acoustical vibrations of variable strengths in his speaking telegraph.—*Journal of the Telegraph.*

THE JABLOCHKOFF ELECTRIC LIGHT AT THE WEST INDIA DOCKS.

THE first trial of this electric light in England was made on Friday evening the 15th June, in the West India Docks, and it was made with the view of testing its applicability to the purpose of lighting up the docks, warehouses, and similar establishments, in order that work may be carried on during the night when necessary. A large number of scientific gentlemen and others interested in the question were present upon the occasion. Among the company were Sir J. M'Garel Hogg, M.P., Mr. E. J. Reed, M.P., Captain Sale, R.E., and several members of the Royal Engineers' Committee—Major de Winton, Mr. Latimer Clark, C.E., Mr. F. H. Webb, C.E., Mr. W. Adams, C.E., and others. The proceedings commenced soon after 9 p.m. with the lighting of four electric lamps in the courtyard at the entrance of the docks. The lamps were arranged at distances 45 ft. from each other in one direction, and 20 ft. in the other. The light of the electric candle in each lamp was subdued by being transmitted through ground glass globes. The light was steady after the first few minutes, and that of one lamp was sufficient to enable small print to be easily read twenty yards away. The light was produced from one of the Alliance Company's (Paris) electro-magnetic machines, having thirty-two magnets of six plates each, and being driven by a small portable steam-engine. After burning for a quarter of an hour the electric lights were extinguished, and four gas-lamps, each having four of Bray's No. 6 burners and four powerful reflectors, were lighted. The contrast was very marked, the gas burning with a dull yellow light, which barely lighted the surrounding space. The visitors then proceeded to the top story of one of the larger warehouses, which was lighted with three of the electric candles placed at considerable distances apart, and in the windows of the building. The floor was about 120 ft. long by 65 ft. wide, and the light was most efficient when not obstructed by the shadows of the visitors moving about. A portable electric light was next carried down into the hold of a large vessel, and its efficiency in that respect was fully demonstrated, as it was also by an electric light on the quay. By the aid of these lights, properly arranged, the loading and unloading of ships could be carried on at night. As a final experiment a candle composed of pure kaolin with a copper wire run through its centre was ignited by the battery and burnt slowly away. It gave a bright light, and was intended to show the applicability of the pure kaolin to purposes where only moderate lights were wanted. The carbon points on candles will only burn for about an hour, but M. Jablochkoff arranges four of these candles in each lamp, and as one is consumed another is ignited by a simple switch arrangement, so that the continuity of the light is hardly broken. The whole of the experiments were highly satisfactory, and indicate an important advance in the utilisation of the electric light—firstly, as regards the supersession of clockwork; and secondly, with respect to the divisibility of the stream of electricity which renders it possible to burn several lights with a single current.—*Times.*

APPS' PATENT INDUCTORIUM.

THE magnificent Inductorium the property of Mr. Spottiswoode, F.R.S., Treasurer of the Royal Society, is the most powerful that has yet been constructed, and reflects the highest credit upon Mr. Apps, its designer and maker. It will, no doubt, prove of immense service for experimental researches which require electricity of very high tension to be employed.

The coil is provided with two primaries: one being arranged for producing long and thin sparks, that is, electricity of a very high potential but low quantity, and the other for producing sparks of shorter length but of greater quantity.

The first of these primaries has an iron core, constructed of a bundle of carefully annealed iron wires, each ·032 in. in diameter and 44 in. long, the total diameter of the bundle being 3·56 in., and its weight 67 pounds.

The primary wire for this core is of copper, of high conductivity, ·096 in. in diameter and 660 yards long. The wire is wound in one length, and forms

six layers, the number of turns being 1,344. It reaches to within one inch of the ends of the iron core, and has a total weight of 55 pounds, its resistance being 2·3 ohms.

The second primary has an iron core composed of wires of the same length and gauge as the first, but forming a bundle 3·81 in. in diameter, and weighing 92 pounds.

The primary wire for this core is, like the first, of ·096 in. diameter. It is 504 yards long, and is wound in double strand, so as to form three pairs of layers of the respective resistances—·181 ohms, ·211 ohms, and ·231 ohms, the total weight being 84 pounds. Each layer has its ends brought out separately, so that the wires can either be connected up for "quantity" or "intensity."

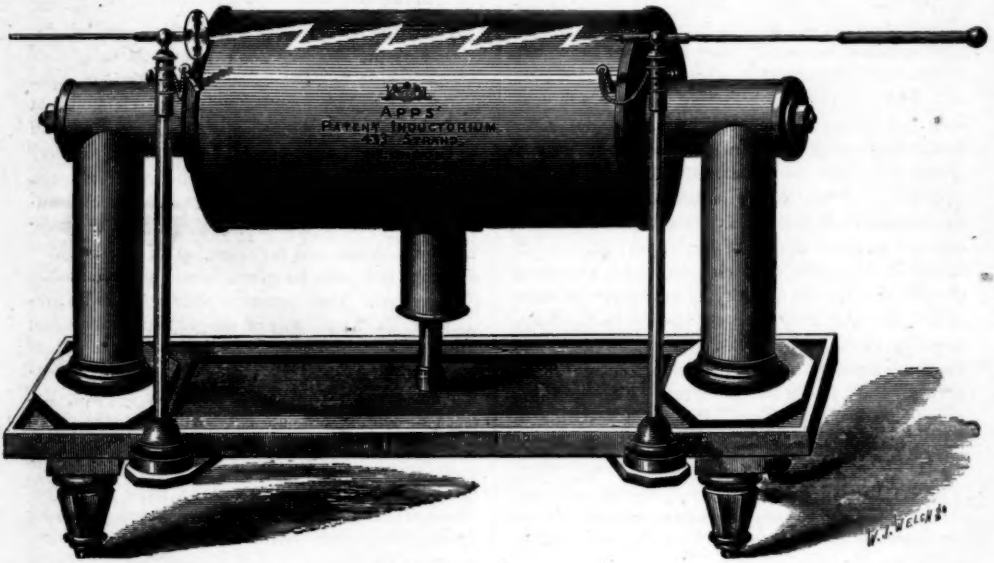
The secondary wire is of the astonishing length of 280 miles. It is wound in four sections, side by side, the two central ones being of wire ·0095 in. in diameter, and the outer ones of wire ·0115 in. and ·0110 in. diameter, this larger wire being, in fact, placed at the part of the coil where the potential of the electricity is greatest.

The wire is wound in about 200 layers, separated, we believe, by gutta-percha tissue, and making 341,850 turns.

The primary and secondary coils are separated by a thick ebonite tube.

The condenser, which is of a comparatively small size, is formed of 126 sheets of tinfoil, 18 in. × 8·25 in. Each sheet is placed between two sheets of varnished paper, which is found to answer best for induction coils, the sheets being 19 in. × 9 in.

The length of spark produced by the coil is as follows, the battery used being Grove's, with 6¼ in. × 3 in. platinums :—



NUMBER OF CELLS.			LENGTH OF SPARK.
5	...	...	28 in.
10	...	...	35 „
30	...	...	42 „

In testing the coil, as many as 70 Grove's cells were tried, but without affecting the insulation in the slightest degree.

The ebonite work of the coil is a very fine piece of work, and was executed, we believe, by the Silvertown India-rubber Company.

Notes.

IN our next issue we propose to publish a portrait of Faraday. It has been reproduced for this Journal by the Woodbury Permanent Process, from a very fine photograph taken by Mr. J. E. Mayall, of Brighton.

ARRANGEMENTS for the repair of the Western and Brazilian Telegraph Company's cables between Para and Pernambuco, and the establishment of communication with Maranham, have been concluded with the Telegraph Construction and Maintenance Company (Limited).

CAPTAIN SEYMOUR, of H.M.S. *Orontes*, before starting from Portsmouth for the Cape, applied to the Admiralty to be supplied with one of Kelway's patent electric logs, which provide for the registration on board at regular intervals of the work done in the water by the ordinary patent log, without

the necessity of hauling it in. The application, we are pleased to learn, was granted, and the inventor took passage to Kingstown (at which port the *Orontes* was to call) to superintend its working. This is the first occasion of the electric log being adopted on board Her Majesty's ships.

IN a paper recently read to the French Société d'Encouragement, M. Gonlier says that nickels deposited electrically have various magnetic actions, whether from the composition of the bath (which may contain iron) or other causes. For manufacture of instruments containing a magnetic needle, one may procure not only brass but German silver, without notable magnetic action—an important fact, since some very able makers have said it was impossible to find brass influencing the needles less than half a degree. Further, instruments containing a needle must not be nickelised, where a very fixed orientation of this needle is necessary. This does not exclude nickels of massive compasses, which are exposed to great causes of deviation. M. Gonlier thinks it desirable that chemists and physicists should ascertain the quantity of magnetic action of nickel, for the nickel of commerce in Germany contains 10 to 12 per cent. of iron, while that of England contains only 2 per cent., and the differences of effect in the two cases may be due to these variations of composition. It is also desirable to find why commercial nickel, which is very magnetic, gives in German silver merely an inert alloy, whereas in brass very small quantities of iron render this alloy so magnetic as to exclude it from manufacture of instruments with a magnetic needle. —*English Mechanic.*

THE Cable between England and the Channel Islands is interrupted.

THE death has just lately been announced of Mr. John Stephen, electrician, who for some years was the acting manager in Edinburgh and Leith of the Electric and International Telegraph Company. Shortly before the affairs of the company were handed over to Government Mr. Stephen retired, and after that time he was occupied chiefly in literary pursuits. He was one of the earliest promoters of the scheme for the transference of telegraphs to the State, on which subject he issued several pamphlets, &c. He died at the comparatively early age of 42 years.

THE *Athenæum* states that attempts have been made to illuminate the Salon, Paris, by means of the electric light, which is said not to decompose colour. A qualified success was attained, but the result cannot be accepted as satisfactory. Considerable difficulty is found in regard to softening the light on the one hand and equalising it on the other.

THE authorities of the town of Milan have decided to introduce a system of electric lighting in certain streets and avenues of that place. The proposition emanated from MM. Allegri Emanueli and Soli. The matter had been discussed very seriously, and studied by a commission, whose report had decided the authorities to act. The town, in consequence, voted the sum of £6,000 to make a trial, which took place in the cathedral yard.

A PATENT has just been granted to one of the editors of the *Evening Bulletin* and *Morning Call* newspapers of San Francisco for a method of rapid telegraphing of stereotyped plates. It is claimed that by this process an entire page of a newspaper can be transmitted by telegraph in from fifteen to thirty minutes, delivering the copy directly from the instrument in such form that it can be handed immediately to the printers. In other words, the copy will be a substantial reproduction of the original, except that it may be given in a larger-sized letter if so desired. The stereotype plate requires no preparation for the purpose of telegraphic transmission other than the filling of all its depressions, or spaces between the faces of the letters, with a non-conducting substance which may be quickly applied, the faces of the type being left clean by means of an equally simple process. The plate thus prepared is placed upon a cylinder arranged to revolve rapidly, so as to present each successive letter in fingers attached to a travelling frame. As the cylinder bearing the plate revolves the frame gradually advances by the operation of a screw; and thus each and every line is successively presented to the fingers or magnetic points above-mentioned. Necessarily the circuit is open when the points are passing over the non-conducting surface; but as often as the metal type presents itself to the said fingers the circuit is closed, and the corresponding magnetic points or pens at the receiving station make the record there in the same letter as the original, delineated in a series of fine lines either upon chemically prepared or ordinary paper fixed upon a corresponding cylinder at the receiving station.

WE understand that the Oriental and American Telegram Company, Limited, whose system of agencies in North and South America, India, China, Australia, &c., has for some time been at work, is now in course of organising agencies to the West Indies. A considerable proportion of the traffic to the West Indies originating from the Continent of Europe, in all the principal cities of which the Company has established agencies under the management of carefully selected officers, it

seems probable that its efforts to extend its system in this direction will be attended with very satisfactory results. For some time past this company has supplied at small cost to subscribers daily reports of the opening and closing of all the principal markets on the Continent and in America, and we believe we are justified in saying that the advantages of these reports to subscribers has been found to be great.

City Notes.

Old Broad Street, June 30, 1877.

WE frankly confess that Mr. Pender and his friends have won the day. Step by step they have accomplished the purpose they had in view when they purchased a large portion of the stock of the Direct Company. Mr. Pender has become the Chairman of the Direct Company; he has carried into effect the "joint purse" scheme, and the Anglo-American and Direct are now practically amalgamated. It only remains for the Globe Trust to cover both with the shelter of its protecting wings.

But that will be the final move. Mr. Pender will probably be content for the next few months to rest on his oars and devote a little of his time to his parliamentary duties. Besides, we have Mr. Pender's word that in the settlement between the Direct and the Anglo-American Companies the Globe Company was "kept out of sight altogether." The suspicions of the shareholders of the united companies must not be excited, for even gentlemen who voted for Mr. Pender's resolutions have not the utmost confidence in the Globe Trust. Perhaps, too, the forthcoming report of the Globe Trust is not so encouraging as Mr. Pender could wish. We have, as our readers well know, opposed the amalgamation of the Direct and Anglo-American Companies from first to last. Our reasons for doing so have been that we do not believe it is possible to maintain a monopoly of the Atlantic traffic; that the Direct, and possibly the Anglo Company, if left in the hands of practical men, as distinct from financiers and speculators, might be made to yield steady and increasing dividends; and that the terms of amalgamation were drawn up in a manner most unfavourable and unfair to the shareholders of the Direct Company. A poll has been taken, and it is, we are aware, decreed by a large majority that things shall be as Mr. Pender desires them to be. But putting matters at their best, is it to be supposed that if a reasonable dividend can be paid on the enormous capital of the two companies, a new one will not be established? We do not think, however, that the amalgamated companies will have so much time given them. The Direct Company was ostensibly, and we believe honestly, formed for the purpose of breaking up the monopoly of Atlantic telegraphy, and affording the public a cheaper medium for communication with America, and for America with us. On this understanding its shares were largely purchased, and its cable freely used. Now that the monopoly it was to break up is established again, capitalists will certainly be forthcoming, either to form an entirely new company or to carry out the proposed Franco-American scheme. It is because we are so deeply interested in the progress and development of ocean telegraphy that we regret the adoption of a policy which cannot fail to shake public confidence. If competition in the future could be bought out, Mr. Pender's scheme might be capable of some sort of justification. But it would even then be based upon purely selfish motives. The public is not likely to put up with prices, whether for the transmission of messages to the United States or for anything else, which are manifestly extravagant, and which may *be brought down*. We repeat, monopoly, for any length of time, is absolutely impossible.

We have said, and we cannot say it too frequently, that the present condition of affairs has been accomplished by speculators and jobbers. The Direct Company, during the time Mr. Lushington was chairman, may have made blunders—but only such blunders as are common to a young company. It was proceeding on the right track, and—in spite of all that has been alleged to the contrary—was rapidly growing into a formidable rival to the Anglo-American. Of course, it was this very fact that led to the intervention of Mr. Pender and his satellites. It did not suit their purpose that the Anglo Company should suffer, or that the cost of ocean telegraphy should be cheapened. Their stake in the former was too great: they knew that if the tariff of the Direct remained at its original rate the Anglo would have to be permanently fixed at the same. A permanent reduction would have entailed disaster. Every other interest was sacrificed in order that the interests of Mr. Pender and his fellow speculators might be promoted.

That the entire scheme for amalgamation has been drawn up with a view to benefit holders of Anglo-American stock is beyond all question. We refuse to take into consideration the verdict of the meeting last Tuesday. Mr. Pender meant to have a majority, and he had it. We deal with figures. In the special report of the Direct Company, which formed the subject of discussion at the meeting, we find that 75 per cent. of the actual receipts, after deduction of traffic charges and payments out, are allotted to the Anglo, and 25 per cent. to the Direct, Company. But it is notorious that the Direct Company does more than one-fourth of the whole traffic of the Atlantic; and 25 per cent. is decidedly an insufficient proportion. Not content with exacting 75 per cent. of the gross receipts, the gentlemen who conceived the amalgamation scheme decree that the Direct Company is to pay £10,000 per annum to the Anglo Company so long as it has two or more cables in working order. Bearing in mind that the two companies have now four cables at work, and that a fifth is shortly to be raised, it will not be a very difficult task for the Anglo to earn its £10,000 per annum. Yet at the meeting this monstrous proviso was allowed to pass. We can but infer that the shareholders are not only powerless to oppose the parties who have determined to destroy the individuality of the Direct Company, but are also powerless to insist upon any modification of the terms. We did think that the modest demand of £10,000 a year for nothing would have excited a storm of remonstrances, though we can imagine it was supposed remonstrances would be wasted. The reception Mr. Spicer received was not reassuring. We notice, with some amusement, that amongst the benefits to result from the adoption of the agreement is one that "Ample security would be obtained, the payment in respect of which security is far out-balanced by the savings in repairs and in other out-payments in respect of traffic." Exactly; there will be only two cables to keep in repair instead of five. We are likewise told that a fair return upon the capital may be immediately reckoned upon; numerous economies will be effected in the administra-

tion, and means will be available to provide a reserve fund. We shall be curious to see what figure the reserve fund starts.

All these benefits are, according to the report, to accrue to the Direct Company; but it is, by way of *finale*, admitted that "the Board consider that the Anglo Company also will reap substantial advantages from the arrangement." It is said that the father of lies is sometimes surprised into speaking the truth. There are people who try to cover misrepresentations by one honest statement. In the next breath the old Adam asserts itself, for we learn that the Board "ventures to think that the negotiations have resulted in a combination which, if adopted, will be disadvantageous to neither of the Companies, and profitable to both, securing to the public a most reliable and efficient service." Or, possibly, in this paragraph Mr. Pender simply exhausted his power of sarcasm. If he had placed the word "economical" after "efficient" he would have left nothing to be desired.

It is possible that there may be one bitter drop in Mr. Pender's cup. The original shareholders of the Direct Company, or such as opposed the resolutions, are able, under a clause of the Limited Liability Act, to insist upon being paid cash for their shares, instead of the paper of the new company. Many of them will, no doubt, avail themselves of their right, and Mr. Pender may expect a considerable claim against the Company before the week is completed. The withdrawal of the original shareholders cannot fail to be a blow to the newly constituted company.

It is not surprising that at the extraordinary general meeting of the Anglo Company Lord Monck should congratulate his shareholders upon the final settlement of the "joint purse" arrangement with the Direct Company. We are not sure that the Anglo shareholders will continue to rejoice at the bargain Mr. Pender has made for them; but, on the surface, they have good reason to be somewhat jubilant. Lord Monck was careful to remind the shareholders that hostile competition would now be done away with; but Lord Monck is as powerless as any one else to control the movements of enterprising capitalists, nor can he persuade the public that a high rate is preferable to a low one.

The report of the Eastern Telegraph Company (thanks, not to Mr. Pender, but to the inherent vitality of the enterprise, combined with good management) presented to the half-yearly meeting is fairly satisfactory. We have deprecated several attempts which have been made to puff this Company—we shall always condemn puffery of any kind in connection with any concern—but it affords us pleasure to acknowledge signs of prosperity in the report. The increase in the reserve fund is not a great achievement, but it has a healthy look, and the reserve fund is well invested. We decline to indorse the advice of a critic, who avers that Eastern Telegraph Shares are a cheap investment at their present price of £7 15s. per £10 share, because we cannot allow ourselves to indulge in such sanguine hopes as some persons have formed respecting the future of this Company. And, in spite of all Mr. Pender's specious pleas, we shall continue to hold it would be a bad thing for the Eastern Extension Company, possibly for the Eastern itself, if the efforts which are still being made, steadily, if silently, to bring about amalgamation were successful. Surely, however, even many who believed in amalgamation will change their minds now that they are able to realise the position of the unfortunate shareholders of the Direct Company. Mr. Pender is very clever, but the scales are beginning to fall from before the eyes of some of his disciples, and Mr. Pender knows the difference between men who are blind and men whose sight is good.

Review.

The Art of Electro-Metallurgy. By C. GORE, LL.D., F.R.S. (Longmans, Green, & Co., London.)

THIS book, which is another of the well-known series of text-books of science published by Messrs. Longman, is written for students and practical workers in the art of electro-metallurgy, gilders, platers, &c., and, as stated by the author in the preface, for all persons who wish to obtain in a compact form an explanation of the principles and facts upon which the art of electro-metallurgy is based.

To say that the book is the best of its kind would be paying but a poor compliment to it, as but very little has been written upon the subject which Mr. Gore treats, and which he treats in a masterly manner.

The opening chapter contains a carefully strung-together historical sketch of the various processes and inventions which have contributed to the great success which electro-metallurgy has attained. From this chapter we learn that the first decidedly practical form in electro-gilding was that of Brugnatelli, who, in 1805, gilded two silver medals, by making them the negative pole in a solution of ammonuriet of gold.

In the succeeding chapters the various difficulties to be encountered are well considered and pointed out, and the way to avoid them is shown. The illustrations, though not plentiful, for indeed there is no necessity that they should be so, show well the different implements required to carry on the various processes.

Altogether the book is one which we may well recommend to all practical electro-metallurgists, and also to those who wish to study the subject, and to make themselves acquainted with its minutest details.

Proceedings of Societies.

ROYAL SOCIETY.

ELECTROSTATIC CAPACITY OF GLASS.

By J. HOPKINSON, D.Sc., M.A. Communicated by Prof. SIR WILLIAM THOMSON, F.R.S.

THE instruments used in the experiments were—a guarding condenser the distance between the plates of which could be varied and measured; a sliding condenser which could be adjusted so that its capacity was equal to the former; the quadrant electrometer used as an electroscope; a battery of 72 Daniell's elements.

The method of experiment was to connect the middle of the battery with the lower plate of the guarding condenser and with the case of the electrometer, to charge one condenser from one pole of the battery, the other from the opposite pole, to insulate both, add their charges, and then connect them to the quadrant of the electrometer. The condensers are equal when there is no deflection of the image. Two experiments are needed in each case—1st, the glass plate is introduced into the guarding condenser, and the sliding condenser is made equal to it; 2nd, the glass plate is removed, and the guarding

condenser is made equal to the sliding condenser. The two readings of the screw which measures the distance of the plates of the former give the specific inductive capacity of the glass.

Four samples of flint glass were successfully examined with the following results :—

	Density.	Electro-static capacity.	Ratio.	Index of Refraction for line D.
Light flint	3·2	6·85	2·14	1·574
Double extra dense flint	4·5	10·1	2·25	1·710
Dense flint	3·66	7·4	2·02	1·622
Very light flint	2·87	6·57	2·29	1·541

Two samples of the first of these glasses were examined, taken from different meltings, and made at different times ; they gave the same result. It will be remarked that these determinations do not bear out Prof. Maxwell's conclusion that the square of the refractive index for long waves is equal to the product of the electrostatic capacity and the magnetic permeability. The quotient electrostatic capacity ÷ density for these glasses and also for solid paraffine lies between 2·0 and 2·3.

PHYSICAL SOCIETY—JUNE 9, 1877.

Prof. G. C. FOSTER, President, in the chair.

THE following candidates were elected members of the Society : Mr. W. H. Northcott and Mr. L. J. Whalley.

Mr. S. P. THOMPSON read a paper on "Interference Fringes" within the Nicol prism. After referring to the original paper by the inventor in 1828, in which this phenomenon was referred to, he gave a general description of it prior to explaining the cause. If the field of a Nicol be explored by the eye it will be seen to be bordered on one side by a margin of violet-blue light, and on the other, when the light passes obliquely through the prism, by an orange band, within which lie a series of coloured fringes. These latter are very clearly seen with monochromatic light, when a second set within the blue band also appears. The author showed that these two sets are due to interference taking place within the film of balsam at the critical angle of total reflexion for ordinary and extraordinary rays respectively. They are therefore analogous to the interference bands in a thin film placed beneath a prism of a more highly refracting substance, and occurring just within the limit of total internal reflexion, as first observed by Sir W. Herschel.

At the conclusion of the scientific business of the Society a special general meeting was held.

ERRATUM.—In the report of the meeting of this society, held on the 12th of May, for "more remote object" read "less remote object."

Electrical Science in Foreign Journals.

POGGENDORFF'S ANNALEN DER PHYSIK UND CHEMIE.

No. 11 : 1876.

(*Continued from page* 132.)

Remark on the Division of the Positive Metal, in a Galvanic Battery, among two Acids. By M. FUCHS.

IF two batteries are opposed, of which the one has, in a given volume, the same quantity of sulphuric acid as the other, but also a quantity of acetic acid, the difference of potential of the first is always, *cet. par.*, somewhat less than that of the second. The decrease of the electro-motive force through presence of the acetic acid, without diminution of the concentration of the sulphuric acid, at least shows clearly that a division of the zinc takes place among the two acids.

On Phenomena of Motion in Electrified Mercury Surfaces. By M. HERWIG.

ONE pole of a Holtz machine being connected metallically with the surface of mercury in a shallow insulated dish, while the other is connected to earth, wave-like motions occur in the mercury, when discharges take place on a separation of the poles. The number of impulses is according to the number of discharges (varying with striking distance, &c.). The force of the impulses is determined by the amount of potential of the free electricity at the mercury surface. The case is that of repulsions of similarly electrified particles of mercury by each other ; the mercury itself is no way changed. Some capillary experiments were also made. A mercury drop on a glass plate flattens at once when strongly electrified. The depression of mercury in a capillary tube is lessened on electrification. In an inclined conical glass tube, holding mercury against the force of gravity, the mercury can be caused to fall by electrification. The passage of electricity to the glass surfaces, in such cases, plays an important part. A stronger action is observable in the positive electricity.

On the Galvanic Behaviour of Gold, and a New Form of Nobilis Rings. By M. SCHIEL.

SPONGY gold (produced by slow admission of a solution of pure gold chloride into a boiling solution of a reducing substance, *e.g.* oxalic acid in great excess) is used as anode in diluted sulphuric acid. The cathode gets coated with a dark precipitate of gold, and sends a dark cloud through the liquid, which throws down a good deal of the fine dark blue powder; some oxide is here mixed with the gold. Rings are produced as follows: A gold plate is put in a porcelain dish, containing water with a little nitric acid; a pointed platinum wire, coated with percha as far as the point, is applied in the middle, and connected with the positive electrode of a battery, while a ring-shaped platinum wire is supported a few millimetres higher above the plate, and connected with the cathode. The current is stopped after nine or ten minutes, and the plate, washed and dried, shows a number of pale concentric rings, which, after being in direct sunlight a few hours, present beautiful bright colours. In alkaline solutions also the gold is attacked, but less strongly.

Correspondence.

London, June 26, 1877.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—We beg to be allowed space to demur to some of the conclusions come to in your leading article of the last number of THE TELEGRAPHIC JOURNAL, especially to the opinion expressed in the last paragraph, that the pneumatic system lately introduced in Vienna will probably become the accepted system of the future. That system contains the inherent weakness of every method of synchronising clocks where the motive power of the hands is the synchronising medium in keeping them to time. Any injury to time-wire or tube, as the case may be, stops every clock in connection. The only system which business men can ever sanction must be one which leaves their office and public clocks with their own proper propelling power uninterfered with when the synchronising work is for any reason temporarily deranged. Such a system we claim, not to have originated, but, to have developed and perfected

by our new "synchronisers," and we, justly we think, point to the list of forty of the cream of the City institutions and mercantile firms who have adopted our system—on which City circuit some fifty clocks are now kept to time—as an unanswerable proof of its perfect success; and we confidently wait the time when it will work its own way and become the means of securing our present erratic public and private timekeepers in unanimity of testimony as to what o'clock.

We remain,

Yours respectfully,

BARRAUD & LUND.

Patents.

76. "Insulating supports of telegraph wires."—J. C. and G. FULLER, January 8, 1877.

118. "Electric telegraph apparatus for delivering printed messages."—J. H. GOOCH, January 10.

121. "Improved means for lighting gas by electricity."—P. DRONIER, January 10.

127. "Improvements in the means and apparatus for telegraphing, applicable also for registering or recording electrical action."—SIR J. ANDERSON, H. N. BLACKWOOD PRICE, and H. G. CHARMAN, January 10.

160. "A new electric automatic indicator for electric bells for house telegraphy and other purposes."—T. COAD, January 12.

197. "Multiple telegraphs."—E. G. BREWER, January 15.

270. "Apparatus for generating electricity."—C. F. VARLEY, January 20.

302. "Galvanising and metal coating apparatus."—J. LYSAGHT, January 24.

374. "Improvements in transmitting and printing telegraphic messages, and in apparatus therefor, and also in type-writing processes and apparatus therefor."—S. WILLIAMS, January 29.

421. "Electric logs."—A. M. CLARK, January 31. (A communication.)

430. "Electric telegraphs."—J. H. JOHNSON, February 1. (A communication.)

492. "An improved apparatus for generating electricity and motive power."—P. JABLOCHKOFF, February 5.

515. "Improvements in telegraph posts and in the method of fixing the same."—J. M. NORMAN, February 7.

522. "Improvements in fixing the insulators of electric telegraphs."—J. H. CORDEAUX, February 7.

653. "Electric bell indicator and thief detector."—A. G. STOCKWELL, February 17.

691. "Electric telegraphs."—J. C. L. LOEFFLER and R. W. H. P. HIGGS, February 20.

732. "Electro-magnetic engines."—J. H. LOVEL, February 22.

829. "Means and apparatus for galvanising iron and coating it with zinc and tin."—F. BRABY and A. C. MOORE, March 1.

833. "Improvements in electric telegraph apparatus and in insulated electric telegraph conductors and pipes or troughs connected therewith."—W. T. HENLEY, March 1.

851. "Improvements in electric telegraph apparatus particularly applicable to submarine cables of great length."—F. TOMMASI, March 2.

855. "Improvements in protecting submarine and subterranean telegraph cables and wires from the destructive effects of teredo, white ants, and other marine and terrestrial animalculæ and insects."—T. G. GLOVER, March 3. (A communication.)

902. "Thermo-electric batteries."—C. & L. WRAY March 6.

1023. "Apparatus for electro-plating wire."—E. T. HUGHES, March 14. (A communication.)

1116. "Improvements in electric batteries, together with the mode of and apparatus for separating iron and other metals from their ores, and in generating electricity and thermo-electricity by or during the electro-deposition of such ores."—W. B. BRAIN, March 21.

1273. "Improved apparatus for generating and applying electricity for medical purposes."—A. M. CLARK, March 31. (A communication.)

1387. "Improvements in electric apparatus for actuating railway brakes, which improvements are applicable to other automatic brakes actuated by steam, compressed air, vacuum, or other power."—F. F. A. ACHARD, April 9.

1416. "Improvements in protecting submarine and subterranean telegraph cables and wires from the destructive effects of teredo and other marine and terrestrial animalculæ and insects."—H. A. C. SAUNDERS & A. JAMIESON, April 11.

1475. "Printing telegraph instruments."—F. H. W. HIGGINS, April 14.

1486. "Galvanic batteries."—E. BLAKY, April 16.

1572. "Gilding frames of wood, putty, papier maché, and all other non-metallic substances by means of a galvanic battery."—A. J. DUPUIS & J. O. SCHULZ, April 23.

1583. "Means and apparatus for generating electricity by steam or heat."—C. CLAMOND, April 23.

1598. "An improved watchman's electric tell-tale and fire alarm."—W. J. HANCOCK & S. M. YEATES April 24.

1599. "Improvements applicable to electric telegraph apparatus."—G. T. PATTERSON, April 24.

1602. "Telegraphic discs and signalling apparatus."—A BROWNE, April 25. (A communication.)

1640. "Improvements in and relating to chemical telegraphs."—W. R. LAKE, April 26. (A communication.)

1655. "Construction of mariners' compasses."—J. ADKINS, April 28.

1693. "An improved expansion and contraction coupling for signal and telegraph wires."—G. VICKERSGILL, May 1.

1702. "Producing and recording electric signals for telegraphic purposes."—F. H. VARLEY, May 2.

1788. "Apparatus for evaporating brine and obtaining salt therefrom (galvanising or electro-plating cylinder)."—J. H. W. BIGGS, May 8.

1829. "Improvements in electro-magnetic apparatus for developing motive power, and for other purposes."—R. WERDERMANN, May 10.

1871. "Means and apparatus for recording electric telegraph signals."—C. H. SIEMENS, May 14. (A communicatfon.)

1896. "Manufacture of metallic cartridge and shells (electro depositing copper on brass)."—W. R. LAKE, May 15. (A communication.)

2041. "Apparatus for correcting and adjusting compasses."—F. FRASI and W. GOODSALL, May 25.

2122. "Binnacles."—R. H. HYNE, May 31.

To Correspondents.

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